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Lessons Learned from Third Party Process Safety Management Audits

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Abstract

OSHA is contemplating revising the Process Safety Management (PSM) Standard, 29 CFR 1910.119, to require third party compliance audits. The author has facilitated over 50 third party PSM compliance audits and participated in numerous PSM-related incident investigations and assisted clients in addressing OSHA citations. The results of third party audits often uncover issues not previously detected in the facilities' internal audits.

This session will address lessons learned and include examples of issues third party auditors identified that had not been detected by internal auditors. Examples of deficiencies noted include, but are not limited to:

- Documenting Thickness or Corrosion Measurement Locations (TML / CML)
- Inclusion of flares, vent systems and small bore piping in the Mechanical Integrity Program
- Failure to delineate PSM-critical equipment vs. operational-critical equipment
- Lack of credit factors for risk mitigation
- Failure to include Critical Operating Limits and Consequences of Deviation in Operating Procedures
- Relief valve design and management
- Operator training, certification and documentation
- Closure of vague and all-encompassing Process Hazard Analysis (PHA) findings and recommendations
- Emergency work orders and the lack of a Management of Change (MOC)
- Arkansas heaters and coolers
- Erroneous Piping and Instrumentation Diagrams (P&ID's) and other Process Safety Information (PSI) used in PHA's
- Failure to identify, classify and investigate PSM-related incidents

Background Information

Following tragic events such as the 1984 Bhopal, India incident as well as several high-profile industrial accidents around the United States in the late 1980's and early 1990's, amendments to the Clean Air Act (CAA) were enacted into law on November 15, 1990. Under Section 304 of the Clean Air Act, OSHA promulgated the Process Safety Management Standard (29 CFR 1910.119) in 1992 to protect workers from accidental chemical releases. To protect the public and environment beyond the regulated facility's property line, U.S. Environmental Protection Agency promulgated the Risk Management Rule (49 CFR 68) in 1996, adopting many of the same prevention measures from the PSM standard for facilities regulated by both rules.

Since the inception of the OSHA standard, the author has facilitated or participated in over 50 compliance audits or GAP Analyses in the United States, Canada, the United Kingdom and Germany. The purpose of this document is to review common compliance deficiencies found during the course of these audits and GAP Analyses.

Special Emphasis Programs – Process Safety Management

OSHA implemented two (2) National Emphasis Programs (NEP) to assist with the control of workplace hazards associated with facilities regulated by the PSM standard:

1. OSHA Instruction, CPL 03-00-014 - PSM Covered Chemical Facilities National Emphasis Program [1], with an effective date of 11/29/2011, was issued to describe policies and procedures for a National Emphasis Program to reduce or eliminate the workplace hazards associated with the catastrophic release of highly hazardous chemicals.

2. OSHA Instruction, CPL 03-00-010 - Petroleum Refinery Process Safety Management National Emphasis Program [2], with an effective date of 8/18/2009, describes policies and procedures for implementing a National Emphasis Program to reduce or eliminate the workplace hazards associated with the catastrophic release of highly hazardous chemicals at petroleum refineries. This document is still in effect, but Federal inspections of all refineries have been completed, and there are no inspections currently programmed. However, this NEP may still provide guidance for State Plan Offices with program refinery inspections within their jurisdictions.

Both documents provide useful information to auditors by providing insight as to how OSHA conducts enforcement actions.

Modernizing Policies and Regulations

In OSHA's published fact sheet dated June 2015, [3] the Department of Homeland Security (DHS), EPA and OSHA have all made significant progress in updating key regulatory programs designed to protect and prepare the community, protect workers and secure facilities.

1. EPA issued a request for information (RFI) seeking public comment on updating its Risk Management Program (RMP) regulation and a Notice of Proposed Rulemaking is being prepared.

2. OSHA issued an RFI in November 2013 seeking public input on possible improvements for its Process Safety Management (PSM) standard and, in June 2015, initiated a *Small Business Regulatory Flexibility Review Act* (SBREFA) panel to get feedback from small businesses.

3. OSHA issued new policies clarifying interpretations on chemicals without concentrations listed in Appendix A and defining Recognized and Generally Accepted Good Engineering Practices (RAGAGEP).

4. Both EPA and OSHA are considering new requirements in PSM and RMP for the use of safer technology and alternatives. As an interim measure, the agencies issued a joint alert promoting the use of safer technologies and alternatives. This alert includes information on best practices from industry and is the beginning framework for safer technology and alternatives.

5. In December 2014, the President signed into law the *Protecting and Securing Chemical Facilities from Terrorist Attacks Act*, establishing a multi-year authorization for the Chemical Facility Anti-Terrorism Standards (CFATS) program.

6. On August 8, 2014, DHS issued an Advanced Notice of Proposed Rulemaking ANPRM to collect information on updates to its Chemical Facility Anti-terrorism Standard (CFATS). Listening sessions were held in several states, including two (2) webinars, in which members of the public were able to participate and provide comments.

7. The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) has initiated a Notice of Proposed Rulemaking to amend the Federal explosives regulation that currently requires explosives licensees and permittees to report explosives storage to local fire authorities when they commence storage. The amendment proposes to require annual notification, which will ensure that local fire authorities are better informed and prepared in case of an accident.

The current OSHA PSM Standard [4] contains the following elements:

- Employee Participation
- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Training
- Contractors
- Pre-Startup Safety Review
- Mechanical Integrity
- Hot Work Permit
- Management of Change
- Incident Investigations
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

What follows is a listing of the most frequently observed PSM program deficiencies. Those items marked with an asterisk (*) are examples of deficiencies overlooked by internal auditors.

Process Safety Information (PSI)
29 CFR 1910.119 (d)

1. The PSI did not address the hazardous effects of inadvertent mixing of different materials that could forseeably occur.

2. The PSI did not include:

    - Maximum intended inventories, including quantities stored in railcars and other transportation containers
    - Safe upper and lower operating limits and never-exceed limits (based on equipment design specifications)
    - Evaluations of the consequences of deviations
    - The area electrical hazard classification
    - The relief system design and design basis
    - The vent system design basis (for occupied buildings in the process areas)
    - The equipment and process design codes and standards employed. This is a common problem with designs that originating from outside the United States. *
    - Documentation that equipment complies with recognized and generally accepted good engineering practices and specifically which ones. *

3. The piping and instrumentation diagrams (P&ID's) did not show or reference:

    - Safety systems, process controls and instrumentation.
    - Expansion joints or hoses and referencing of the specifications for each. *
    - Pipe specifications or reference thereto.

Process Hazard Analysis (PHA)
29 CFR 1910.119 (e)

1. The PHA methodology was not appropriate to the complexity of the process. As a result numerous hazards were overlooked or not identified.

2. The PHA did not take into consideration previous incidents that had a likely potential for catastrophic consequences.

3. The PHA was performed by a team but lacked expertise in one (1) or more of the following areas:

    - Engineering and Process operations
    - A person knowledgeable of the specific process
    - A person knowledgeable in the PHA methodology

4. There is no system for tracking the status of control actions resulting from PHA's.

5. There was no documentation of temporary controls put in place to address a specific hazard while permanent controls are being developed. For example, what actions are being taken to protect building occupants from over pressure due to an explosion while a new building or control room is built?

6. There is no system to communicate the PHA results and the status of action items to affected operations and maintenance personnel.

7. The company's maximum "acceptable level of risk" has not been defined. * As a result, there is no system to quantify the potential level of risk associated with a hazard and what level is unacceptable to the company. **Note:** This is a good management practice (GMP).

8. Credit factors for mitigating risk have not been established. * (GMP) What is the value of an engineering control as opposed to an administrative control? How many controls are required to reduce the level of risk to that which is acceptable to the company?

9. Credit factors for mitigating risk are not documented in the "recommendations " section of the PHA worksheets. * (GMP) If the recommendation is implemented, what will be the resulting risk level? Management needs this information to make intelligent decisions.

10. The team failed to evaluate the potential for operator overload from alarms and tasks in an emergency.

11. Failure to evaluate the need for automatic and remote operated isolation valves for critical equipment. *

12. Failure to evaluate possible building over-pressure in event of an explosion (temporary and permanent buildings).

13. Failure to evaluate the quality and reliability of critical instruments and controls.

14. Failure to evaluate the risk of heat exchanger failure and the need for early detection and warning.

15. Failure to evaluate the hazards presented by blow down drums and flares. *

16. Failure to verify the accuracy of the process safety information, including but not limited to, standard operating procedures and the piping and instrumentation diagrams.

17. Failure to walk through the facility prior to conducting the PHA to identify any major deficiencies and the potential for critical piping to be struck by vehicular traffic.

18. PHA documentation is kept only on computer using commercially available software, but there is no one available who can access and print the data when needed. In some cases the

information was lost when computers crashed, and there was no back up of the data. In other cases the individual who led the PHA was the only one trained to use the PHA software and no longer works for the company.

19. Failure to record and retain the actual documents or reference material used in the PHA (P&ID's and SOP's including document name and / or number, issue and revision dates).

Operating Procedures
29 CFR 1910.119 (f)

1. Operating procedures do not include:

    - Emergency shutdown including the conditions under which emergency shutdown is required and the identity by job title of those responsible for authorizing shutdown.
    - Critical operating limits, never-exceed limits, including the consequences of deviation and the steps required to correct or avoid deviation.
    - Quality control for raw materials and control of hazardous chemical inventory levels.
    - Operating procedures do not include or reference all of the safety systems and their intended functions. Safety systems include but are not limited to:

        - Pressure control systems and alarms
        - Temperature control systems and alarms
        - Level control systems and alarms
        - Flow control systems and alarms
        - Pressure relief systems, including pressure safety valves, rupture disks and disposal of the relieved material
        - Process interlocks and emergency shutdown systems
        - Flammable and toxic gas detection systems
        - Fire protection systems

2. Operating Procedures are only available electronically and not available in hard copy for use in event of power failure.

3. Operating procedures are not reviewed at least annually and certified as current and accurate.

4. Pre-startup and shutdown checklists mandated in the operating procedures are not used or completed.

5. Operating logs sheets are not completed and audited. *

6. Work Permit Procedures such as Lockout / Tagout, Line Entry and Confined Space Entry are not audited.

7. Gas testing equipment used to issue work permits is not properly calibrated and bump-checked. **Note:** This is also a Mechanical Integrity issue.

8. Safety systems are by-passed without authorization. *

Training Programs
29 CFR 1910.119 (g)

1. Operator refresher training has not been performed at least every three (3) years.

2. Operator training documentation does not include one (1) or more of the following:

    - The identity of the employee
    - The date of the training
    - The means to verify the employee understood the training.

3. Operations personnel cannot locate operating procedures and Safety Data Sheets (SDS's) in the computer.

4. Operators cannot explain or describe conditions requiring emergency shutdown.

5. There was no documentation to indicate how site personnel were consulted on the frequency of refresher training.

Contractors
29 CFR 1910.119 (h)

1. There is no procedure for evaluation of prospective contractors' safety performance and procedures.

2. There is no documentation that the facility obtained and evaluated contractors' safety performance prior to issuing a contract to work on or near a covered process.

3. There is no documentation of contractor orientation concerning potential fire, explosion or toxic release hazards related to the process.

4. There is no documentation of the facility's safe work practices relative to Lockout / Tagout, Confined Space Entry, Line Entry and entry into covered processes by contractors.

5. There is no documentation the facility is auditing contractor compliance with safe work practices, such as but not limited to Lockout / Tagout, Confined Space Entry, Line Opening, Management of Change (MOC) requirements, PPE requirements and Emergency Reporting and Response Procedures.

6. There is no listing or log of contractor employee injuries and illnesses that occur in PSM-covered areas.

Pre-Start Up Safety Reviews (PSSR)
29 CFR 1910.119 (i)

1. PSSR's are not always performed and documented prior to start-up of new processes or after major process modifications that require a change in Process Safety Information.

2. PSSR's do not always address:

   - Verification that construction and equipment meet the design specifications.
   - Safety, operating, maintenance and emergency procedures are in place and are adequate.
   - PHA action items have been resolved / implemented before start-up.
   - Operators and maintenance personnel have been appropriately trained.

Mechanical Integrity Program
29 CFR 1910.119 (j)

1. The facility does not have a list of the following types of PSM critical equipment:

   - Pressure vessels and storage tanks
   - Piping systems
   - Pressure relief devices
   - Instruments
   - Pumps

   Note: To ensure that all PSM-critical equipment has been covered in the Mechanical Integrity (MI) Program, check the PHA. If the PHA team listed an instrument or piece of equipment as a safeguard, it should be identified on the PSM-critical equipment list.

2. There is no documentation that maintenance or contractor employees who perform maintenance and service work have been trained in an overview of the process and its hazards.

3. There are no (or insufficient) written procedures for maintenance and inspection of process equipment.

4. There is no documentation that contractor personnel who service or repair PSM covered equipment have been trained in the facility maintenance procedures. *

5. Inspections and tests are not being performed on process equipment in accordance with the facility's schedule, which should be based on generally accepted good engineering practices. **Note:** One (1) reason for overdue inspections is that non-PSM covered equipment has been erroneously included for inspection and overtaxes the system. *

6. There are no procedures to assure that maintenance materials and spare parts are suitable for the process application for which they are used.

7. There is no Positive Materials Identification (PMI) of metallic parts or equipment components. This is critical when exotic metals are used. Equipment exists on the market today to identify metallurgy very quickly.

8. Checks of critical instrumentation and safety devices may include a loop check (that a signal was sent and received) but often fail to include an actual operational check to assure that the controller functioned as intended (i.e., valve opened or closed as intended or the equipment shut down). *

9. Facilities have indicated that they have adopted certain industry standards (such as API, ANSI, etc.) for the inspection and testing of tanks, pressure vessels and piping but have not fully implemented the requirements of the adopted standards nor have inspection personnel been trained and certified to perform such inspections. *

10. On stream leak repairs and kits are not evaluated as part of the MOC process. *

11. There is no documentation that personnel who made welds or repairs on ASME code vessels were actually qualified to do so.

12. There is no (or incomplete) documentation as to what repairs or adjustments were made by service / maintenance personnel.

13. There was no documentation to indicate that maintenance and service personnel were trained and certified to perform tasks such as but not limited to:

    - Welding
    - Non-destructive testing
    - Pressure relief valve testing and repair

14. There was no procedure indicating what measures must be taken if inspection or test results are outside the minimum acceptable criteria.

15. There was no documentation as to what was actually done when inspection / test results on PSM critical equipment were outside the minimum acceptable limits.

16. Piping inspections do not include pipe supports and hangers.

17. There is no process to address anomalous readings. *

18. Repairs made on code vessels are not properly documented including, but not limited to, R-1 Reports and detailed traveler packages.

19. Small bore piping is often not covered in the inspection and testing process. *

20. No record is kept of the Thickness Measurement Locations (TML's) sometimes referred to as Corrosion Measurement Locations (CML's). In addition, there is no rationale documented as to the number and location of the TML's. *

Hot Work
29 CFR 1910.119 (k)

1. The facility does not have a Hot Work Permit system that documents the fire prevention and protection requirements for welding and cutting as outlined in 29 CFR 1910.252(a)(2)(iv).

2. The Hot Work Permits are not correctly completed in that one (1) or more of the following is missing:

    - Date
    - Identity of object being welded

3. Critical equipment such as cable trays, sumps and sewers are not adequately protected from slag and sparks generated by hot work.

4. Fire Watch personnel cannot accurately describe their duties and responsibilities.

Management of Change (MOC)
29 CFR 1910.119 (l)

1. There is no written procedure to manage change to a covered process with respect to changes in process chemicals, technology, equipment and procedures or stationary sources.

2. MOC procedures do not address one (1) or more of the following items:

    - Technical basis for the proposed change
    - Impact on safety and health (and the methods for doing so)
    - Modifications to operating procedures
    - Time period for the change
    - Authorization / approval requirements

3. Employees affected by the proposed changes are not informed / trained on the changes prior to implementation.

4. PSI is not updated when a change is made.

5. Operating, maintenance, safety or emergency response procedures are not updated when a change is made.

6. Temporary changes are allowed to become permanent without the required review and approval.

7. Emergency changes do not go through a formal review process.

8. The MOC process is so cumbersome that personnel look for ways to circumvent the system. One way to check for this is to review completed emergency work orders. The author often finds numerous tasks performed on an "emergency" basis without the required MOC.

9. The design basis for flares, vents and blow down systems are not reviewed when changes are made to equipment upstream.

10. Equipment-specific lockout / tagout and confined space isolation procedures are not covered by the MOC process resulting in inaccurate isolation plans. *

11. The use of "Arkansas Coolers and Heaters" (water or steam hoses on process equipment) are not covered by an MOC. *

12. Leak repair kits and clamps are not covered by an MOC. *

Incident Investigation
29 CFR 1910.119 (m)

1. Incidents that did or could have resulted in a "catastrophic release" of regulated substances are not investigated. The OSHA PSM Standard defines a catastrophic release as a "major uncontrolled emission, fire or explosion, involving one (1) or more highly hazardous chemicals, that presents serious danger to employees in the workplace". Many companies mistakenly think that only those events that did, or had the potential to release more than the threshold quantity of a covered material need to be investigated. The author reviews the list of environmental releases as part of the PSM audit to identify PSM events that may have been overlooked.

2. The incident investigation was not started within 48 hours of having knowledge of the event.

3. The incident investigation was not conducted by a team comprised of at least one (1) person knowledgeable of the process and a contractor representative, if a contractor was involved.

4. The incident investigation report did not contain the required information relative to the date of the incident, the date the investigation began, a description of the incident, factors contributing to the event and any recommendations.

5. The facility does not have a system to promptly address and resolve incident report findings and recommendations.

6. The final report was not reviewed with all affected parties.

7. Incident Investigation reports are done in phases and updated online, but there is no complete and final report. *

Emergency Response Procedures
29 CFR 1910.119 (n)

1. The site emergency response plan does not include:

    - An organizational statement indicating the level of response site personnel are expected to provide with respect to fire fighting and spills or releases of hazardous materials
    - Procedures for informing the public and local emergency response agencies about accidental releases.
    - Procedures and measures for emergency response after an accidental release of a regulated substance.
    - Training for all employees in relevant procedures.

2. The site emergency response plan has not been coordinated with the community emergency response plan.

3. There is an insufficient number of properly trained HAZMAT and / or Fire Brigade personnel to respond to emergencies on the night, evening and weekend shifts. *

Compliance Audits
29 CFR 1910.119 (o)

1. Audits were not done once every three (3) years.

2. Audits did not address all PSM-covered areas.

3. "Draft" reports were never finalized.

4. There was no documentation to indicate the status of audit action items.

5. Audit findings were overly broad or too vague to establish correction action plans. *

6. The audit protocol was not documented.

Suggestions for Improving Your PSM / RMP Compliance Audits

The Pros and Cons of Using Third Party Auditors

Pros

1. Third party auditors can provide a degree of independence and an unbiased view. They have usually seen multiple sites and processes. Internal auditors often have no outside experience or perspectives. They only know what they know; they don't know what they don't know.

2. Third party auditors are usually trained in the auditing process and have a documented audit protocol. Internal auditors often have no formal training in the auditing process.

3. Third party auditors often have a great deal of auditing experience and have a documented sampling strategy; internal auditors often have little auditing experience and do not have a sampling strategy.

4. Third party auditors usually "peel the onion" several layers deep. They field verify PHA and MOC closures as well as the car sealing of isolation valves on the inlet and outlet of pressure relief devices. The author frequently finds completed checklists indicating the car seals on the isolation valves on the inlet and outlet of relief valves are in place, but the car seals are actually missing and valves are closed. Internal auditors sometimes fail to field verify closure of PHA and MOC action items and operator checklists.

Cons

1. Some third party auditors, particularly those who retired from a single refinery or petrochemical facility, often have a limited perspective based on their experience. They sometimes become advocates for "the way they did it" as opposed to auditing with an open mind and looking for alternative means of compliance.

2. Some third party auditors are good auditors but have little process experience and are unable to understand and apply the PSM standard in a real world environment.

Improving the Audit Process

1. Consider using a team consisting of one (1) or more third party auditors and facility personnel. Don't overlook the value of using operations and maintenance personnel from the hourly ranks. Having these individuals on the team illustrates that the company is truly involving employees in the PSM program. It also demonstrates to the workforce the sheer magnitude of the PSM regulations and why compliance is critical. If and when a regulator arrives to conduct an inspection, these individuals can support the company by explaining to the regulator exactly how things are done at the site. If you involve site personnel on your audit team, take the time to provide them with an overview of the OSHA and EPA standards, the audit protocol and auditing techniques.

2. Consider using an independent third party as your audit team leader or facilitator. This will add credibility to the audit. While there is great value in using site personnel to serve on the audit team, an experienced outside auditor may bring up issues that have not been previously identified. Keep in mind we don't know what we don't know. When selecting an outside auditor, a person who has actual plant experience as well as auditor training and experience will give you the most bang for your buck.

3. Develop, publish and maintain a Critical Documents Locator. Such a document should indicate where PSM / RMP-related documents are located and who is responsible for keeping them current and accessible.

4. Have the audit team conduct short daily briefings with the site management team (no more than 30 minutes) to discuss any areas of concern and / or resolve any questions relative to the elements being audited.

5. Mandate that the audit team provide you with a draft report for review to assure that the audit is accurate and that findings are not overly broad or too vague. Remember, any audit deficiencies will need to be addressed. You want the auditors' findings to be very specific.

6. Don't shoot the messenger, but do not hesitate to ask the auditor(s) to clarify his or her findings. Everybody concerned wants an accurate assessment of the company's PSM program. Keep in mind that some auditors are advocates for what they believe is correct or have seen in the past and may not be auditing to the applicable standards. Don't hesitate to ask for additional information to support the auditor's findings.

7. Once the audit is complete and the report has been accepted, assemble a team to address each and every audit finding. Audit findings should be put into some sort of action tracking database and managed aggressively. If an audit deficiency will require engineering or capital, make sure you document what control measures will be taken in the interim. Document closure to each and every action item. If a finding was found to be in error, be sure to document the inaccuracy and any information supporting your opinion.

8. Communicate the results of the audit findings and action items with all affected personnel.

Conclusion

The author sincerely believes that compliance with the OSHA PSM and EPA RMP regulations is just good business. Keep in mind that both sets of regulations are performance based and give each facility latitude in implementing their program. However, these regulations have been in effect for over 20 years. What was considered to be an acceptable standard of care in 1992 may not be acceptable by today's standards.

Since the inception of the regulations, many additional resources have been developed by such groups as the American Institute of Chemical Engineers, the American Petroleum Institute and the American Chemistry Council. Plant personnel and regulators have a greater knowledge of process safety management techniques and industry best practices. Regulatory agency inspections are much more in-depth than they were even five (5) years ago. Companies are being issued citations for failure to meet "Recognized and Generally Accepted Good Engineering Practices" (RAGAGEP). One only has to look at the results of some of the refinery and chemical plant special emphasis inspections to see the trends. Compliance audits should

help us continuously improve employee and public safety, while protecting the environment and the viability of the industry. How good is your audit process?

References

1. U. S. Department of Labor, Occupational Safety and Health Administration (OSHA), OSHA Instruction, Directive Number CPL 03-00-014, PSM Covered Chemical Facilities National Emphasis Program, issued 11/29/2011.

2. U. S. Department of Labor, Occupational Safety and Health Administration (OSHA), OSHA Instruction, Directive Number CPL 03-00-010, Petroleum Refinery Process Safety Management National Emphasis Program, issued 8/18/2009.

3. U. S. Department of Labor, Occupational Safety and Health Administration (OSHA) Fact Sheet, "Actions to Improve Chemical Facility Safety and Security", OSHA Web Site, 06/2015

4. U. S. Department of Labor, Occupational Safety and Health Administration (OSHA), 29 CFR Part 1910.119, RIN 1218-AB20, Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents; Final Rule, Issued 2/24/1992.